

1. An interactive device for use in conjunction with images displayed on a computer display apparatus and a fixed surface, comprising:

a stylus including a longitudinal axis, a lateral axis, and a vertical axis;

a mechanical linkage coupled to a fixed surface and coupled to said stylus for supporting said stylus while allowing at least five degrees of freedom in the motion of said stylus, said mechanical linkage providing a user the ability to manipulate the orientation and location of said stylus in three-dimensional space, said five degrees of freedom including rotation about said longitudinal axis, revolution about its lateral axis, turning about its vertical axis, and spatial movement along at least two other axes relative to said fixed surface, said rotation, revolution and turning degrees of freedom providing said orientation of said stylus, and said spatial movement degrees of freedom providing said location of said stylus; and

means for producing an interactive stylus locative signal which on command by a user is responsive to and corresponding with the position and movement of the stylus at any point in time during its normal operation, said stylus locative signal providing information about the orientation, location, and movement of said stylus for use by a computer display apparatus to manipulate images displayed by said computer display apparatus in accordance with said orientation, location, and movement of said stylus.

3. A device as recited in Claim 1 wherein said stylus locative signal means is in communication with said mechanical linkage.

4. A device as recited in Claim 1 wherein said stylus locative signal means is in communication with said stylus.

5. A device as recited in Claim 1 further comprising:
a remote unit having switch capable of being in an on state and an off state; and
command means triggered by said switch when said switch is in its on state for generating a command signal for receipt by a computer.

6. A device as recited in Claim 5 wherein said remote unit is a foot pedal unit.

7. A device as recited in Claim 1 wherein said mechanical linkage includes at least three joints.

8. A device as recited in Claim 1 wherein said mechanical linkage includes three individual components.

9. A device as recited in Claim 1 further comprising means for providing resistance to the motion of the stylus.

10. A device as recited in Claim 1 wherein said stylus has pencil-like configuration which can be manually manipulated.

11. A device as recited in Claim 1 further comprising:

feedback means for generating a force on said stylus in at least one of said at least five degrees of freedom in response to force signals provided to said device, said force signals correlated to information displayed on computer display apparatus.

12. A method for interactively interfacing a user and a computer display apparatus, comprising the steps of:

providing a stylus including a longitudinal axis, a lateral axis and a vertical axis;

coupling to said stylus a mechanical linkage coupled to a fixed surface for supporting said stylus while allowing at least five degrees of freedom in the motion of said stylus, said mechanical linkage for providing a user the ability to manipulate the orientation and location of said stylus in three-dimensional space, said at least five degrees of freedom including rotation of said stylus about its longitudinal axis, revolution of said stylus about its lateral axis, turning of said stylus about its vertical axis, and spatial movement of said stylus along at least two other axes relative to said fixed surface, said rotation, revolution and turning degrees of freedom providing said orientation of said stylus, and said translation degrees of freedom providing said location of said stylus; and

providing means for producing an interactive stylus locative signal which on command by a user is responsive to and corresponding with the position and movement of the stylus at any point in time during its normal operation, said stylus locative signal providing information about the orientation and location of said stylus for use by a computer display apparatus to position and move an object displayed by said computer display apparatus in accordance with the location, orientation, and movement of said stylus.

14. A method as recited in Claim 13 wherein said stylus locative signal means is in communication with said mechanical linkage.

15. (amended) A method as recited in Claim 13 wherein said stylus locative signal means is in communication with said stylus.

16. (amended) A method as recited in Claim 13 further comprising the steps of:

providing a remote unit having switch capable of being in an on state and an off state; and

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conel providing a command signal generator triggered by said switch when said switch is in its on state for generating a command signal for receipt by a computer.

17. A method as recited in Claim 16 wherein said remote unit is a foot pedal unit.
18. A method as recited in Claim 13 wherein said mechanical linkage includes three individual components.
19. A method as recited in Claim 13 wherein said mechanical linkage includes at least three joints.
20. A method as recited in Claim 13 further comprising means for providing resistance to the motion of the stylus.
21. A method as recited in Claim 13 wherein said stylus has pencil-like configuration which can be manually manipulated.
22. A method as recited in Claim 13 further comprising the steps of:

providing feedback means for generating force on said stylus in at least one of said at least five degrees of freedom in response to force signals provided to said mechanical linkage, said force signals correlated to information displayed on computer display apparatus.
29. A device as recited in Claim 1 wherein said mechanical linkage provides said stylus with six degrees of freedom.
30. A method as recited in Claim 13 wherein said mechanical linkage provides said stylus with six degrees of freedom.
31. A device as recited in claim 27 wherein said means supportable on a fixed surface and coupled to said stylus provides the ability to track said motion capabilities of said stylus by appropriately placed sensors.
32. A method as recited in Claim 28 wherein said means supportable on a fixed surface and coupled to said stylus provides the ability to track said motion capabilities of said stylus by appropriately placed sensors.
33. A device as recited in claim 1 wherein said images displayed by said computer display apparatus include an object that is positioned and moved in accordance with the position and movement of said stylus.
34. A device as recited in claim 11 wherein said feedback means generates a force on said stylus by generating a force on a joint included in said mechanical linkage in response to said force signals.

35. (amended) An interactive device for use in conjunction with a computer display apparatus and a fixed surface, comprising:

a stylus;

a mechanical arm linkage coupled to a fixed surface and coupled to said stylus for supporting said stylus while allowing a plurality of degrees of freedom in the motion of said stylus, said mechanical arm linkage providing a user the ability to manipulate the orientation and location of said stylus in three-dimensional space;

D₂ a sensor coupled to said mechanical arm linkage for sensing said orientation and said location of said stylus and providing a stylus locative signal to a computer display apparatus, said stylus locative signal providing information about said orientation and location of said stylus for use by said computer display apparatus to manipulate an [object] image displayed by said computer display apparatus in accordance with said orientation and location of said stylus; and

a transducer coupled to said mechanical arm linkage for providing a force along at least one of said plurality of degrees of freedom of said stylus in response to a stylus force signal generated by said computer display apparatus.

36. An interactive device as recited in claim 35 wherein said mechanical arm linkage includes two linkages and three joints.

37. An interactive device as recited in claim 35 wherein said transducer provides said force in conjunction with movement of said object displayed on said computer display apparatus.

38. An interactive device as recited in claim 35 wherein said mechanical arm linkage allows six degrees of freedom in the motion of said stylus.

Please add the following claims:

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D₃ 39. (new) A system for controlling an electromechanical interface apparatus manipulated by a user, the system comprising:

a host computer system for receiving an input control signal and for providing a host output control signal, wherein said host computer system updates a displayed process in response to said input control signal;

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a processor separate from said host computer system for receiving said host output control signal from said host computer system and providing a processor output control signal;

an actuator for receiving said processor output control signal and providing a force along a degree of freedom to a user manipulable object coupled to said actuator in accordance with said processor output control signal; and

a sensor for detecting motion of said manipulable object along said degree of freedom and outputting said input control signal including information representative of the position of said object.

40. (new) A system as recited in claim 39 wherein said sensor outputs said input control signal to said processor, and wherein said processor provides said input control signal to said host computer.

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41. (new) A system as recited in claim 40 wherein said processor is operative to provide said processor output control signal to said actuator in accordance with a processor subroutine selected in accordance with said host output control signal.

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42. (new) A system as recited in claim 40 wherein said object is a stylus grasped and moved by said user.

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43. (new) A system as recited in claim 42 wherein said stylus can be moved by said user in a plurality of degrees of freedom, and wherein said system further comprises, for each of said plurality of degrees of freedom, an actuator for providing a force along a degree of freedom of said object, and a sensor for detecting motion of said object in said degree of freedom.

44. (new) A system as recited in claim 40 wherein said force provided by said actuator is a resistive force to motion of said object in said degree of freedom.

45. (new) A system as recited in claim 40 further comprising a serial interface coupled between said host computer and said processor for outputting said host output control signal from said host computer system to said processor and for receiving said input control signal at said host computer system from said processor.

46. (new) A system as recited in claim 40 wherein said host computer system displays images on a visual output device and manipulates said images in accordance with said position of said object.

47. (new) A system as recited in claim 40 further comprising a peripheral input device coupled to said processor for providing input signals to said processor to be sent to said host computer when a user manipulates said peripheral input device.

48. (new) A method for interfacing motion of an object with a host computer system, the method comprising the steps of:

providing an object having a degree of freedom;

sensing positions of said object along said degree of freedom with a sensor and producing electrical sensor signals therefrom;

utilizing a microprocessor separate from said host computer system to receive said electrical sensor signals, provide said electrical sensor signals to said host computer system, and to receive host commands from said host computer system; and

creating a force on said object along said degree of freedom by using said microprocessor and said host commands to control an actuator coupled to said object.

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49. (new) A method as recited in claim ²⁴48 wherein said microprocessor and said host computer system are coupled together by a serial communication interface.

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50. (new) A method as recited in claim 48 wherein said microprocessor provides processor commands to said actuator in accordance with a processor subroutine selected in accordance with said host commands and stored on a memory device coupled to said processor.

51. (new) A method as recited in claim 48 wherein said host computer system controls and displays visual images on a visual output apparatus in accordance with said positions of said object.

52. (new) A method as recited in claim 51 wherein said object includes a stylus that can be moved by said user in at least five degrees of freedom.

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53. (new) A method as recited in claim ²⁴48 further comprising sending a peripheral command to said microprocessor from a peripheral input device, wherein said microprocessor sends said peripheral command to said host computer system.

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54. (new) An interface device manipulated by a user and communicating with a host computer system displaying visual images on a screen, said host computer system updating said visual images in response to input signals, said interface device comprising:

a processor, separate from said host computer system, for communicating with said host computer system via a communication interface by receiving a host command from said host computer system, said processor being controlled by software instructions stored on a memory device coupled to said processor;

a user object movable in a degree of freedom by a user and being physically contacted by said user;

an actuator electrically coupled to said processor for applying a force along a degree of freedom to said user object in accordance with a processor command from said processor, said processor command being derived from said host command; and

a sensor for detecting a position of said user object along said degree of freedom and outputting said input signals to said host computer system, said input signals including information representative of said position of said user object.

55. (new) An interface device as recited in claim 54 wherein said sensor is electrically coupled to said processor, wherein said sensor outputs said input signals to said processor, and wherein said processor sends said input signals to said host computer system.

56. (new) An interface device as recited in claim 55 wherein said processor is operative to provide said processor command to said actuator in accordance with a processor subroutine selected in accordance with said host command and stored in said memory device.

33/ 57. (new) An interface device as recited in claim 31/ 58 wherein said user object is movable in at least two degrees of freedom.

34/ 58. (new) An interface device as recited in claim 31/ 59 wherein said communication interface includes a serial interface.

35/ 59. (new) An interface device as recited in claim 31/ 60 wherein said actuator applies a resistive force along said degree of freedom to said user object.

60. (new) An interface device as recited in claim 55 further comprising a plurality of linkages in a mechanical arm, at least one of said linkages coupled to said actuator, and at least one of said linkages coupled to said user object, said arm providing at least five degrees of freedom to said user object.

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